CLAIMS

1. The method of making a hybrid substrate assembly comprising the steps of:

providing a semiconductor wafer having a first composition;

implanting an oxide layer within said semiconductor wafer to thereby form a semiconductor membrane on a surface of said semiconductor wafer;

providing a substrate-of-choice having a second composition that is different than said first composition;

wafer bonding said substrate-of-choice to said semiconductor membrane; and

removing said oxide layer to thereby provide a hybrid substrate assembly that includes said substrate-of-choice wafer bonded to said semiconductor membrane.

2. The method of claim 1 including the step of:

aligning a crystalline construction of said substrate-of-choice to a crystalline construction of said semiconductor membrane prior to said wafer bonding step.

3. The method of claim 1 including the step of:

providing a wetting layer intermediate said substrate-of-choice and said semiconductor membrane, said wetting layer having an element that is common to said first composition and said second composition.

4. The method of claim 1 including the step of:

thermally oxidizing said oxide layer prior to said wafer-bonding step.

5. The method of claim 1 wherein said step of implanting said oxide layer within said semiconductor wafer and said step of removing said oxide layer respectively comprise an oxygen-implantation step and an acid-etching step.

6. The method of claim 4 including the step of:

providing a wetting layer intermediate said substrate-of-choice and said semiconductor membrane prior to performing said wafer-bonding step.

7. The method of claim 1 including the step of:

subjecting said hybrid substrate assembly to an annealing step.

8. The method of claim 7 including the step of:

thermally oxidizing said oxide layer prior to said removing step.

9. The method of claim 8 wherein said step of implanting said oxide layer within said semiconductor wafer and said step of removing said oxide layer respectively comprise an oxygen-implantation step and an acid-etching step.

10. The method of claim 9 including the step of:

providing a wetting layer intermediate said substrate-of-choice and said semiconductor membrane prior to performing said wafer-bonding step.

11. The method of claim 1 including the step of:

repeating said implanting step, said wafer bonding step, and said removing step a plurality of times relative to a plurality of substrates-of-choice, to thereby provide a plurality of hybrid substrate assemblies that each include a substrate-of-choice wafer bonded to a semiconductor membrane.

12. The method of making a hybrid substrate assembly comprising the steps of:

providing a wafer selected from SiC polytypes such as 6H-SiC, 4H-SiC, 3C-SiC and 15R-SiC;

forming a SiO_x layer within said wafer to thereby form a wafer membrane on a surface of said wafer;

providing a substrate-of-choice;

wafer bonding said substrate-of-choice to said wafer membrane; and

removing said SiO_x layer to thereby provide a hybrid substrate assembly that includes said substrate-of-choice wafer bonded to said wafer membrane.

13. The method of claim 12 including the step of:

thermally oxidizing said SiO_x layer prior to said removing step.

14. The method of claim 12 including the step of:

providing a wetting layer intermediate said substrate-of-choice and said wafer membrane prior to said wafer-bonding step.

15. The method of claim 14 wherein said wetting layer contains silicon.

16. The method of claim 15 wherein said wetting layer is a layer that contains silicon, such as Si_3N_4.

17. The method of claim 12 including the step of:

annealing said wafer after said forming step.

18. The method of claim 12 including the step of:

annealing said hybrid substrate assembly.

19. The method of claim 12 wherein said substrate-of-choice is selected from a group including Si, SiO_2, polycrystalline SiC, sapphire, polycrystalline AlN, crystalline AlN, diamond and Si_3N_4.

20. The method of claim 12 wherein said wafer is SiC.

21. The method of claim 12 wherein said removing step comprises etching said SiO_x layer in hydrofluoric acid.

22. The method of claim 12 wherein said step of forming said SiO_x layer within said wafer and said step of removing said SiO_x layer, respectively, comprise an oxygen-implantation step and an acid-etching step.

23. The method of claim 12 including the step of:

repeating said forming step, said wafer bonding step, and said removing step a plurality of times relative to a plurality of substrates-of-choice to thereby provide a plurality of hybrid substrate assemblies that each include a substrate-of-choice wafer bonded to a wafer membrane.

24. The method of claim 12 wherein SiO_x is SiO_2.

25. The method of claim 24 wherein said wafer membrane is one micrometer thick or less.

26. The method of claim 12 including the step of:

optimizing said wafer-bonding step by aligning a crystalline nature of said wafer and said substrate-of-choice prior to said wafer-bonding step.

27. The method of making a hybrid substrate assembly comprising the steps of:

providing a SiC wafer;

forming a SiO_x layer within said SiC wafer to thereby form a SiC membrane on a surface of said SiC wafer;

thermally oxidizing said SiO_x layer;

providing a substrate-of-choice;

providing a wetting layer that contains Si intermediate said substrate-of-choice and said SiC membrane;

wafer bonding said substrate-of-choice to said SiC membrane; and

removing said SiO_x layer to thereby provide a hybrid substrate assembly that includes said substrate-of-choice wafer bonded to said SiC membrane.

28. The method of claim 27 wherein said thermal oxidation step takes place in the presence of steam or oxygen.

29. The method of claim 27 wherein said wetting layer is Si_3N_4.

30. The method of claim 27 including the step of:

annealing said SiC wafer after said forming step.

31. The method of claim 27 including the step of:

annealing said hybrid substrate assembly.

32. The method of claim 27 wherein said substrate of choice is selected from a group including Si, SiO_2, polycrystalline SiC, sapphire, polycrystalline AlN, crystalline AlN, diamond and Si_3N_4.

33. The method of claim 27 wherein said wafer is selected from SiC polytypes.

34. The method of claim 27 wherein said removing step comprises etching said SiO_x layer in hydrofluoric acid.

35. The method of claim 27 wherein said step of forming said SiO_x layer within said SiC wafer and said step of removing said SiO_x layer respectively comprise an oxygen-implantation step and an acid-etching step.

36. The method of claim 27 including the step of:

repeating said forming step, said thermal oxidizing step, said providing a wetting layer step, said wafer-bonding step, and said removing step a plurality of times relative to a plurality of substrates-of-choice to thereby provide a plurality of hybrid substrate assemblies that each include a substrate-of-choice wafer bonded to a SiC membrane.

37. The method of claim 27 wherein said SiO membrane is about one micro meter thick.

38. The method of claim 27 including the steps of:

determining a crystalline structure of said SiC wafer and a crystalline structure of said substrate-of-choice; and

physically aligning said crystalline structure of said SiC membrane to said crystalline structure of said SiC wafer prior to said wafer-bonding step.

39. The method of making a hybrid substrate assembly comprising the steps of:

providing a wafer selected from SiC polytypes such as 6H-SiC, 4H-SiC, 3C-SiC, and 15R-SiC;

forming a SiO_x layer within said wafer by means of oxygen implantation, to thereby form a wafer membrane on a surface of said wafer;

thermally oxidizing said SiO_x layer;

providing a substrate-of-choice;

providing a wetting layer that contains Si intermediate said substrate-of-choice and said wafer membrane;

wafer bonding said substrate-of-choice to said wafer membrane; and

removing said SiO_x layer to thereby provide a hybrid substrate assembly that includes said substrate-of-choice wafer bonded to said wafer membrane.

40. The method of claim 39 wherein said thermal oxidation step takes place in the presence of steam or oxygen.

41. The method of claim 39 including the step of:

annealing said wafer after said forming step.

42. The method of claim 39 including the step of:

annealing said hybrid substrate assembly.

43. The method of claim 39 wherein said substrate of choice is selected from a group including Si, SiO_2, polycrystalline SiC, sapphire, polycrystalline AlN, crystalline AlN, diamond and Si_3N_4.

44. The method of claim 39 including the step of:

repeating said forming step, said thermal oxidation step providing a wetting layer step, said wafer bonding step, and said removing step a plurality of times relative to said wafer and relative to a plurality of substrates-of-choice, to thereby provide a plurality of hybrid substrate assemblies that each include a substrate-of-choice wafer bonded to a wafer membrane.

45. The method of claim 39 wherein said wafer membrane is no greater that about one micro meter thick.

46. The method of claim 39 including the steps of:

determining a first crystalline structure of said wafer;

determining a second crystalline structure of said substrate-of-choice;

determining an alignment of said first crystalline structure to said second crystalline structure that will enhance wafer bonding of said wafer membrane to said substrate-of-choice; and

aligning said wafer membrane with respect to said substrate-of-choice in accordance with said determined alignment prior to said wafer-bonding step.